

# UTILITY PATENT APPLICATION TRANSMITTAL (Large Entity)

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Docket No.  
96RSS017,075/73063

Total Pages in this Submission  
35

## TO THE ASSISTANT COMMISSIONER FOR PATENTS

Box Patent Application  
Washington, D.C. 20231

Transmitted herewith for filing under 35 U.S.C. 111(a) and 37 C.F.R. 1.53(b) is a new utility patent application for an invention entitled:

**NEURAL NETWORK FOR CONTROLLING CALLS IN A TELEPHONE SYSTEM**

and invented by:

**Anthony J. Dezonno**

If a **CONTINUATION APPLICATION**, check appropriate box and supply the requisite information:

☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No.: \_\_\_\_\_

Which is a:

☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No.: \_\_\_\_\_

Which is a:

☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No.: \_\_\_\_\_

Enclosed are:

### Application Elements

1. ☒ Filing fee as calculated and transmitted as described below
2. ☒ Specification having 20 pages and including the following:
  - a. ☒ Descriptive Title of the Invention
  - b. ☐ Cross References to Related Applications (if applicable)
  - c. ☐ Statement Regarding Federally-sponsored Research/Development (if applicable)
  - d. ☐ Reference to Microfiche Appendix (if applicable)
  - e. ☒ Background of the Invention
  - f. ☒ Brief Summary of the Invention
  - g. ☒ Brief Description of the Drawings (if drawings filed)
  - h. ☒ Detailed Description
  - i. ☒ Claim(s) as Classified Below
  - j. ☒ Abstract of the Disclosure

I hereby certify that this paper is being deposited with the United States Postal Service as Express Mail in an envelope addressed to: Assistant Commissioner for Patents, Washington, D.C. 20231, on this date.

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(Only for new nonprovisional applications under 37 CFR 1.53(b))

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## Application Elements (Continued)

3. ☒ Drawing(s) (when necessary as prescribed by 35 USC 113)
- a. ☐ Formal Number of Sheets \_\_\_\_\_
- b. ☒ Informal Number of Sheets 3
4. ☒ Oath or Declaration
- a. ☒ Newly executed (original or copy) ☐ Unexecuted
- b. ☐ Copy from a prior application (37 CFR 1.63(d)) (for continuation/divisional application only)
- c. ☒ With Power of Attorney ☐ Without Power of Attorney
- d. ☐ DELETION OF INVENTOR(S)  
Signed statement attached deleting inventor(s) named in the prior application,  
see 37 C.F.R. 1.63(d)(2) and 1.33(b).
5. ☐ Incorporation By Reference (usable if Box 4b is checked)  
The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.
6. ☐ Computer Program in Microfiche (Appendix)
7. ☐ Nucleotide and/or Amino Acid Sequence Submission (if applicable, all must be included)
- a. ☐ Paper Copy
- b. ☐ Computer Readable Copy (identical to computer copy)
- c. ☐ Statement Verifying Identical Paper and Computer Readable Copy

## Accompanying Application Parts

8. ☒ Assignment Papers (cover sheet & document(s))
9. ☐ 37 CFR 3.73(B) Statement (when there is an assignee)
10. ☐ English Translation Document (if applicable)
11. ☐ Information Disclosure Statement/PTO-1449 ☐ Copies of IDS Citations
12. ☐ Preliminary Amendment
13. ☒ Acknowledgment postcard
14. ☒ Certificate of Mailing

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(Only for new nonprovisional applications under 37 CFR 1.53(b))

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## Accompanying Application Parts (Continued)

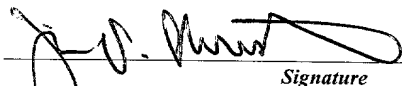
15. ☐ Certified Copy of Priority Document(s) (if foreign priority is claimed)
16. ☐ Additional Enclosures (please identify below):

## Fee Calculation and Transmittal

### CLAIMS AS FILED

For	#Filed	#Allowed	#Extra	Rate	Fee
Total Claims	24	- 20 =	4	x \$22.00	\$88.00
Indep. Claims	3	- 3 =	0	x \$82.00	\$0.00
Multiple Dependent Claims (check if applicable) <input type="checkbox"/>					\$0.00
BASIC FEE					\$790.00
OTHER FEE (specify purpose) _____					\$0.00
TOTAL FILING FEE					\$878.00

- ☐ A check in the amount of \_\_\_\_\_ to cover the filing fee is enclosed.
- ☒ The Commissioner is hereby authorized to charge and credit Deposit Account No. 03-2470 as described below. A duplicate copy of this sheet is enclosed.
- ☒ Charge the amount of \$878.00 as filing fee.
- ☒ Credit any overpayment.
- ☒ Charge any additional filing fees required under 37 C.F.R. 1.16 and 1.17.
- ☐ Charge the issue fee set in 37 C.F.R. 1.18 at the mailing of the Notice of Allowance, pursuant to 37 C.F.R. 1.311(b).

  
Signature

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Dated: October 14, 1998

cc: Sheila Mathews

Date

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96RSS017,075/73063

NEURAL NETWORK FOR CONTROLLING  
CALLS IN A TELEPHONE SWITCH

5

Field of the Invention

The field of the invention relates to telephony systems and more particularly to automatic call distributors used with private networks.

10

Background of the Invention

Automatic call distribution systems are known. Such systems are typically used in an organizational context as a means of distributing telephone calls among a group of agents of the organization.

Often the organization disseminates a single telephone number to its customers and to the public in general as a means of contacting the organization. As calls are directed to the organization from the public switch telephone network (PSTN), the automatic call distribution system directs the calls to its agents based upon some algorithm, typically based upon availability. For example, where all agents are consider equal, the automatic call distributor (ACD) may distribute the calls based upon which agent position (telephone) has been idle the longest.

In order to distribute incoming calls from the PSTN to the available agents, the interaction of a controlling computer with a switching fabric of the ACD becomes essential. Often a connection of the ACD to a local PSTN is in the form of a number of trunk connections. Each of the trunk connections is monitored by the controller for incoming calls. Where a call is detected, the controller searches for and

selects an idle agent. Upon selecting an agent, the controller instructs the switch to form a connection between the incoming trunk and selected agent.

In more complicated systems, the organization may  
5 use a number of telephone numbers to identify different individuals and functions within the organization. Each telephone number may be assigned to a particular incoming trunk or group of incoming trunk lines. As such, the controller may be required to recognize a  
10 call target based upon an identity of an incoming trunk line and route the call accordingly.

In other systems, the ACD of an organization may receive calls directed to different call targets over the same trunk lines. In such a case, the call target  
15 may be identified to the ACD by a pulse code modulated (PCM) signal transferred from the PSTN to the controller of the ACD by a dialed number identification service (DNIS) operating from within the PSTN.

In systems associated with service organizations,  
20 where many calls are received and handled by many agents, it may be important for an agent to have ready access to customer files. In such a situation, a database is maintained of existing customers. Customer records may be displayed on agent terminals as the  
25 agents converse with specific customers. In some cases, the customer may be identified to the database for display of records on the terminal by the agent entering a customer identifier into a keyboard associated with the terminal. Alternatively, the  
30 controller of the ACD may transfer an identifier of the customer to the database based upon an automatic number

identification (ANI) facility, operating from within the PSTN.

Where ANI is used, the controller of the ACD receives the ANI digits (identifying the caller via the caller's telephone number) at the same time the call arrives from the PSTN. Upon selecting an agent, the controller may transfer a call to a queue of the selected agent (or group of agents) or directly to the selected agent. At the same time that the call is delivered to the agent, the controller sends an identifier of the selected agent and ANI number of the customer to a controller of the database (the host). The host, in turn, displays the customer records on a computer monitor of the terminal of the selected agent at the same time the call is delivered.

While the existing method of ACD operation is relatively satisfactory, the relative loading of agent groups varies widely. Often sales campaigns are launched involving some agents of a selected number of agent groups. Other times, agents may be drafted for outbound call campaigns based upon availability. However, the varying levels of call processing may intermittently leave agents handling incoming calls idle. Other times, incoming calls may overwhelm agents designated for accepting such calls. Accordingly, a need exists for a means of dynamically adapting operating resources of automatic call distributors to changing circumstances, such that the dynamic nature of call processing may be accommodated without difficulty.

30

### Summary

A method and apparatus are provided for processing calls in an automatic call distributor. The method includes the steps of learning a set of desired resource relationships for servicing a plurality of call processing load conditions in the automatic call distributor and, afterwards, distributing resources of the automatic call distributor based upon call processor loading and the learned desired set of resource relationships.

### Brief Description of the Drawings

FIG. 1 is a block diagram of an automatic call distributor in accordance with an illustrated embodiment of the invention;

FIG. 2 is a flow chart of process steps performed by the system of FIG. 1;

FIG. 3 is a neural network of the system of FIG. 1; and

FIG. 4 is a neural network of the system of FIG. 1.

### Detailed Description of a Preferred Embodiment

FIG. 1 is a block diagram of an automatic call distributor (ACD) system 10, generally, in accordance with an illustrated embodiment of the invention. The ACD 10 may include a call distributor (CD) 20 coupled to the PSTN 14 through a number of trunk lines 30. The CD 20 may route calls received from the PSTN 14 to a number of agent consoles 28 (one shown in FIG. 1) under the control of a host 16. The host 16 may include one or more neural networks (NN) 32. Each agent console 28

has associated with it, an agent terminal 18 coupled to a database within the host 16.

Under the embodiment, the ACD 10 may direct calls from a number of customers 12 (one shown in FIG. 1) to  
5 a number of agents (one agent station 18, 28 shown in FIG. 1), or calls from a number of agents to a number of customers under the control of the NN 32.

Calls from customers 12 may be initiated from subscriber locations anywhere within the PSTN 14 and  
10 routed by the PSTN 14 to the ACD 10. To facilitate delivery of calls, an owner of the ACD 10 may disseminate by advertising or otherwise, an address for delivery of calls. In the case of calls, the address may simply be a telephone number.

Under the illustrated embodiment, calls delivered  
15 from the PSTN 14 to the ACD 10 under voice format may be handled conventionally. The ACD 10 may include a switch 26, which may be interconnected with the PSTN 14 through a number of trunk lines 30. The PSTN 14 may  
20 offer service on the trunk lines 30 in association with services such as ANI or DNIS. Call control, call maintenance, and call set-up may be accomplished over the trunk line itself or over an associated control channel.

DNIS information supplied by the PSTN 14 is useful  
25 where inbound calls to the ACD 10 may be directed to any of a large block of telephone numbers assigned to the ACD 10. Calls of the block of numbers may be delivered to the ACD 10 through the trunk lines 30 in  
30 rotary fashion, so that when the calling party from the PSTN appears, for example, on trunk T1, it can be determined whether the calling party was, in fact,



calling the telephone number corresponding to trunk T1 or was, in fact, calling the telephone number corresponding to trunk T2 and was rotated down to the next available trunk, T1.

5           The switch 26 is controlled by a central processing unit, or CPU 22, in conjunction with peripheral memory device 24. Control of the switch 26 and communications with the host 16 and PSTN 14 may be accomplished generally as described in U.S. Patent No. 10 5,268,903, and U.S. Patent No. 5,140,611, both to Jones, and both incorporated herein by reference. Routing of calls to agents 28 and overflow of calls may be accomplished generally as described in: U.S. Patent No. 5,335,269 to Steinlicht et al.; U.S. Patent No. 15 5,365,581 to Baker et al.; and U.S. Patent No. 5,384,841 to Adams et al., all incorporated herein by reference.

          During operation, the CPU 22 monitors each port of the switch 26 for changes in status. A change in 20 status may be an agent unit 28 going off-hook to make a call, an agent unit hanging up after a call, or it may be a call alerting tone detected on a trunk, alerting the CPU 22 to the presence of an incoming call.

          Where the status change is an agent 28 hanging up, 25 the CPU 22 acts to tear-down the call connection within the switch 26 between the agent at a first port of the switch and a second party to the conversation communicating through a second port of the switch 26. Upon tear down of the connection, the CPU 22 also sends 30 a message to the host 16, notifying the host of termination of the call connection. The message to the host 16 includes at least the identity of the agent 28.

Where the status change is a call alert signal on an incoming trunk line (or control channel associated with the incoming trunk line), the CPU 22 may send a call arrival message to the host 16 (and NN 32). Based upon system loading, the host 16 may authorized the CD 20 to accept the call. Upon receiving authorization to accept the call, the CD 20 sends an acknowledge message to the PSTN 14 accepting the call. The PSTN 14 may respond by forwarding DNIS and ANI information, identifying the called and calling party.

Upon accepting the call, the CPU 22 first stores the DNIS and ANI numbers in a termination table of the memory 24. More specifically, the CPU 22 maintains a table of call information for each port of the switch 26. Where a call is accepted on an incoming trunk line, the CPU 22 enters the DNIS and ANI number into the table for the incoming trunk line upon which the call is received.

In addition to updating the termination table within memory 24, the CPU 22 also generates a call identifier (also sometimes referred to as a call ID or sequence number) for the call, unique to the switch 26. The call identifier along with the ANI and DNIS numbers may then be sent to the host 16 as part of a call arrival message. The call arrival message includes a header identifying the message as being a call arrival message. The message may also include an ANI number, DNIS information and the call identifier.

Delivery of the ANI and DNIS numbers and call identifier allows the host 16 to create a unique call record for the call in memory 24, in a call record area of memory 24. The call record (and specifically the

ANI information within the call record) may be used to retrieve customer records for delivery to an appropriate display terminal 18 once the call has been assigned to an agent 28.

5           The CPU 22 then, by reference to the DNIS number, determines the identity of an agent 28 to which the call is to be directed. For example, the DNIS number may be used to differentiate between calls directed to a first telephone number arriving on a first incoming trunk group directed to a sales group of the organization from calls directed to a service group of the organization. Since agents servicing sales calls would, in most cases, not handle calls directed to service, the DNIS number provides a convenient means of  
10           differentiating between two or more types of calls.

          The CPU 22 may maintain a series of lookup tables within memory 24 identifying groups and agents within each group. A header of each lookup table may identify the DNIS numbers of calls to be directed to the group.

20           Each group lookup table may contain a list of identifiers of agents assigned to the group. Agents may be added to or deleted from a group under control of the NN 32.

          Also contained within each group list is a status indicator of each agent. Agents may be selected based upon availability or qualifications.

          Upon determining the identity of the agent 28 (or group of agents) the CPU 22 instructs the switch 26 to internally connect the port of the incoming trunk to a port of one of the identified agents.  
30

          Where the call has been connected to an agent, the CPU 22 stores the port number of the identified agent

in the termination table for the port of the incoming trunk. Likewise, the CPU 22 stores the port identifier of the incoming trunk in the termination table of the identified agent.

5       To complete set-up of the call to the identified agent, the CPU 22 sends a call completion message to the host 16. The call completion message may include a header identifying the message as being a call completion message. The call completion message may  
10 also include at least a port identifier of the identified agent and the call identifier. The information of the call completion message is stored in the call record previously created in conjunction with call arrival. The port identifier and call identifier  
15 allows the host 16 to deliver customer data to the specific display terminal of the agent to which the call was delivered.

Included within the host 16 is one or more NNs 32 which control system resources (e.g., the number of  
20 agents in a particular agent group, the number of incoming calls per time period accepted by the system 10, the number of outgoing calls initiated by the system 10, the number of calls in the queue of each group, etc.). Each NN 32 may be created and organized  
25 in a manner well known in the art (e.g., see "AS/400 Neural Network Utility: User's Guide and Reference PRPQ P84189").

The NN 32 may perform an analysis of resource allocation periodically (e.g., one every 10 seconds,  
30 once an hour, etc.), or upon the receipt of each call request. As used herein, a call request may be an

incoming call from the PSTN 14 or an outgoing call initiated by the host 16 as part of a call campaign.

Under the illustrated embodiment, the NN 32 may receive input information on system operation from any number of sources (e.g., from the CD 20, supervisors station 34, etc.). Information received from the CD 20 may include: the number of agents signed onto the system 10, the number of agents available for accepting calls, the delay time which a call experiences before delivery to an agent, an average time a call experiences before answering, an average talk time, a time of day, day of week, etc.

Based upon that information, the NN 32 may assign agents to groups or transfer agents among groups, based upon group loading. The NN 32 may also initiate and control outgoing call campaigns in conjunction with the control of the agent groups. Further, the NN 32 may also control the rate at which the CD 20 accepts calls from the PSTN 14.

FIG. 2 is a flow chart of neural network operation. As shown, the NN 32 may begin by processing the input information to determine a system status. Following a determination of system status, the NN 32 checks to see if group resources are adequate 102.

The determination of whether or not group resources are adequate may be determined by examination of a call queue for each group. Where calls remain in the call queue for an excessive period of time, the NN 32 may determine that the resources of the group are inadequate and that more resources should be allocated to the group.

For example, the NN 32 may first identify the group with the longest and shortest delay of calls in its respective call queue. If the difference is one second or less the NN 32 may determine that the  
 5 resources are adequate and that no action is needed. Alternatively, if the delay is larger (e.g., 10 seconds), the NN 32 may determine that the group with the longest delay has inadequate resources and may re-assign 104 one or more agents of the group with the  
 10 shortest delay to the group with the longest delay.

Upon considering the resources of each group, the NN 32 may next consider whether or not to process a call. Processing a call may mean accepting an incoming call from the PSTN 14 or initiating an outgoing call.  
 15 While the processing of incoming calls may be given priority over outgoing calls, it should be understood that either type may be given priority.

The NN 32 may determine the appropriateness of processing another call by again examining such things  
 20 as a length of time a call spends in a call queue. If the time spent is determined to be excessive, the NN 32 may defer processing of another call. If the time spent in the queue is not excessive, the NN 32 may determine that another call should be processed.

25 Where incoming calls are given priority, the NN 32 may first check to see if there is a call waiting to be answered. If there is a call waiting to be answered, the NN 32 may signal the CD 32 to answer the call.

If there isn't a call waiting to be answered, the  
 30 NN 32 may consider whether or not to initiate an outgoing call. In determining whether to initiate an outgoing call, a different set of weights may be used

for reaching the determination. For example, it may be determined that outgoing calls should not be initiated before 8am or after 5pm or during the weekend.

Consequently, the inputs associated with time of day  
 5 and day of week would have a different neural network weight depending on the type of call processed.

Alternatively, the NN 32 may be used to control a ratio of incoming to outgoing calls. For instance, where an operator of the system 10 is a marketing  
 10 organization, it may be more important (and profitable) to ensure that more calls go out than come in. Under this model, a NN 32 may be used to first initiate calls with some ratio (e.g., 2:1, 3:1, etc.) of outgoing to incoming calls.

15 FIG. 3 is an example of a NN 32 that may be used for a determination of agent resources. Such a NN 32 may be maintained for each agent group associated with the ACD 10. As shown, the NN 32 for agent resources may periodically process n inputs to determine an agent  
 20 resource status. Where it is determined that the group does not have enough agents, an "ADD AGENT" output may go to a "1" state to indicate the need to add an agent to a group. Where it is determined that there are too many agents in a group, a "DELETE AGENT" may go to a  
 25 "1" state. The weights associated with adding agents may be different than the weights associated with deleting agents.

Where the NN 32 of one agent group signals a need for agents, the host 16 may simply look for another  
 30 group which is indicating that it has too many agents. Where a match is found, the host 16 may compare qualifications of the agents of the two groups and

transfer an agent with the appropriate qualification.  
Once such a determination has been made, the host 16  
may send a message to the CD 20 identifying the agent  
and indicating the source and destination agent groups.

5        FIG. 4 depicts a NN 32 that may be used for call  
processing. As shown, a first set of information  
inputs 1-n may be used for a determination of call  
acceptance. A determination to accept a call would  
cause the output "CALL ACCEPT" to go high.

10        Also shown, is an "INITIATE CALL" output. While  
the same set of inputs is shown as being used for  
"INITIATE CALL" and "CALL ACCEPT", it is to be  
understood that some inputs may be used for "INITIATE  
CALL" and not used for "CALL ACCEPT" and visa versa.  
15        This may be accomplished by having a weighting value of  
zero in the one case and not the other, and visa versa.

      The NNs 32 may be created in a manner well-known  
to those of skill in the art. For example, the host 16  
may be an AS/400 by IBM with a software library  
20        containing a neural network utility. An Application  
Programming Interface (API) may be provided for the  
benefit of a supervisor working at a supervisors  
station 34 which allows the supervisor to access and  
use the neural network utility program. Prompts may be  
25        provided to enable the supervisor to select a neural  
network model such as the back propagation model.

      The programmer may also be provided with prompts  
to  
initialize and train the neural network. Following  
30        initialization, the user may be prompted to identify a  
database within the host 16, which may be used to train  
each NN 32. Other screens may be provided through



which the supervisor may input information and adjust the weights given to the input information.

Once the NN 32 has been trained, the NN 32 may be used to allocate system resources, as appropriate. The supervisor, working through the supervisors station 34 may periodically monitor and adjust weighting values of the NN 32 as appropriate to system performance.

A specific embodiment of a method and apparatus of a neural network for controlling calls in a telephone switch according to the present invention has been described for the purpose of illustrating the manner in which the invention is made and used. It should be understood that the implementation of other variations and modifications of the invention and its various aspects will be apparent to one skilled in the art, and that the invention is not limited by the specific embodiments described. Therefore, it is contemplated to cover the present invention any and all modifications, variations, or equivalents that fall within the true spirit and scope of the basic underlying principles disclosed and claimed herein.

### Claims

1. A method of processing calls in an automatic call distributor, such method comprising the steps of:

learning a set of desired resource relationships  
5 for servicing a plurality of call processing load conditions in the automatic call distributor; and  
distributing resources of the automatic call distributor based upon call processor loading and the learned set of resource relationships.

10

2. The method of processing calls as in claim 1 wherein the step of distributing resources further comprises adjusting a ratio of inbound calls to outbound calls based upon the operating level of the  
15 automatic call distributor.

3. The method of processing calls as in claim 1 wherein the step of distributing resources further comprises reassigning an agent of a first group to a  
20 second group.

4. The method of processing calls as in claim 1 wherein the step of learning the set of desired resource relationships further comprises determining a  
25 number of call that have been answered and are in a queue waiting to be assigned to an agent.

5. The method of processing calls as in claim 1 wherein the step of learning the set of desired  
30 resource relationships further comprises determining a number of available agents.

6. The method of processing calls as in claim 1 wherein the step of learning the set of desired resource relationships further comprises determining an average call waiting time of a call in a call queue.

5

7. The method of processing calls as in claim 1 wherein the step of learning the set of desired resource relationships further comprises determining an average call waiting time of a call for each group of a plurality of agent groups of the automatic call distributor.

8. The method of processing calls as in claim 1 wherein the step of learning the set of desired resource relationships further comprises determining a number of calls in a call queue for each group of a plurality of agent groups of the automatic call distributor.

9. The method of processing calls as in claim 1 wherein the step of learning the set of desired resource relationships further comprises determining an average waiting time between call arrival at the automatic call distributor and call acceptance.

25

10. Apparatus for processing calls in an automatic call distributor, such apparatus comprising:  
means for learning a set of desired resource relationships for servicing a plurality of call processing load conditions in the automatic call distributor; and

means for distributing resources of the automatic call distributor based upon call processor loading and the learned set of requirements.

5 11. The apparatus for processing calls as in claim 10 wherein the means for distributing resources further comprises means for adjusting a ratio of inbound calls to outbound calls based upon the loading level of the automatic call distributor.

10

12. The apparatus for processing calls as in claim 10 wherein the means for distributing the resources further comprises means for reassigning an agent of a first group to a second group.

15

13. The apparatus for processing calls as in claim 10 wherein the means for learning the set of desired resource relationships further comprises means for determining a number of calls that have been answered  
20 and are in a queue waiting to be assigned to an agent.

14. The apparatus for processing calls as in claim 10 wherein the means for learning the set of desired resource relationships further comprises means for  
25 determining a number of available agents.

15. The apparatus for processing calls as in claim 10 wherein the means for learning the set of desired resource relationships further comprises means for  
30 determining an average call waiting time of a call in a call queue.

16. The apparatus for processing calls as in claim 10 wherein the means for learning the set of desired resource relationships further comprises means for determining an average call waiting time of a call for each group of a plurality of agent groups of the automatic call distributor.

17. The apparatus for processing calls as in claim 10 wherein the means for learning the set of desired resource relationships further comprises means for determining a number of calls in a call queue for each group of a plurality of agent groups of the automatic call distributor.

18. The apparatus for processing calls as in claim 10 wherein the means for learning the set of desired resource relationships further comprises means for determining an average waiting time between call arrival at the automatic call distributor and call acceptance.

19. Apparatus for processing calls in an automatic call distributor, such apparatus comprising:  
a neural network adapted to learn a set of desired resource relationships for servicing a plurality of call processing load conditions in the automatic call distributor; and

a call processor adapted to distribute resources based upon call processor loading and the learned set of relationships.



# Abstract

A method and apparatus are provided for processing calls in an automatic call distributor. The method includes the steps of learning a set of desired resource relationships for servicing a plurality of call processing load conditions in the automatic call distributor and, afterwards, distributing resources of the automatic call distributor based upon call processor loading and the learned desired set of resource relationships.

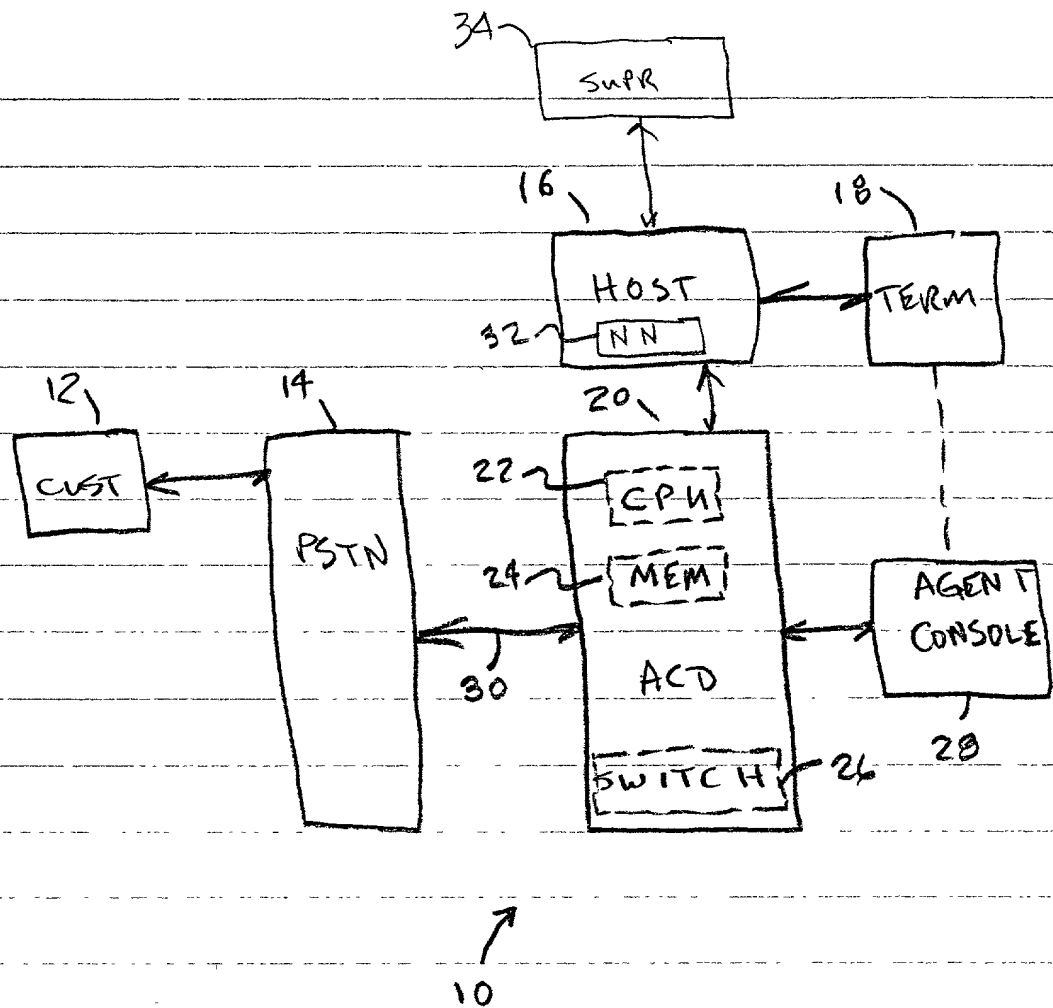


FIG. 1



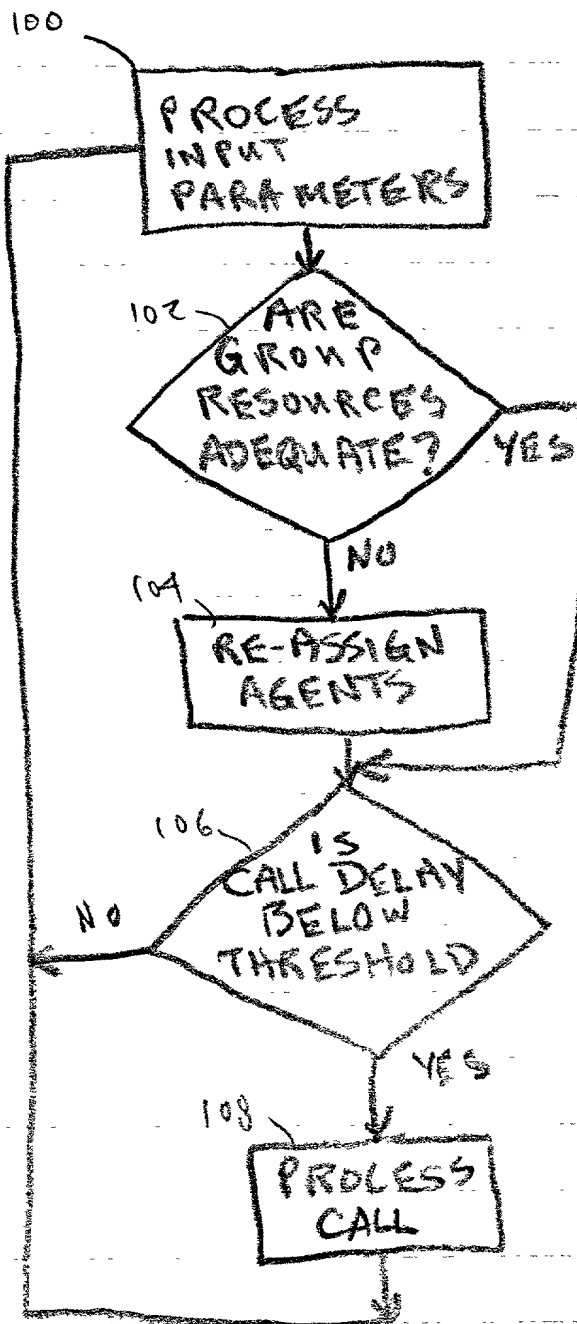


FIG. 2

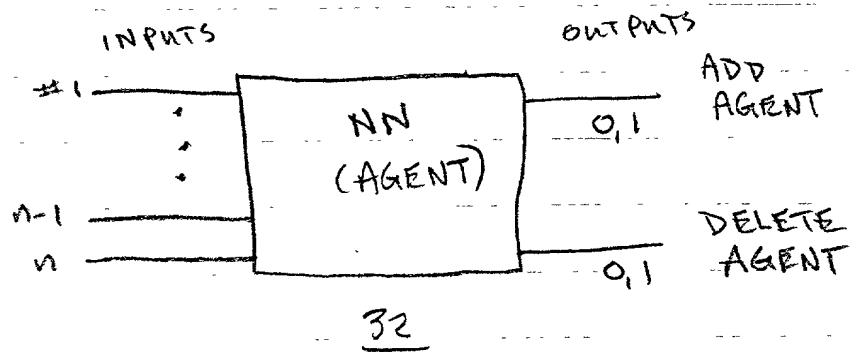


FIG. 3

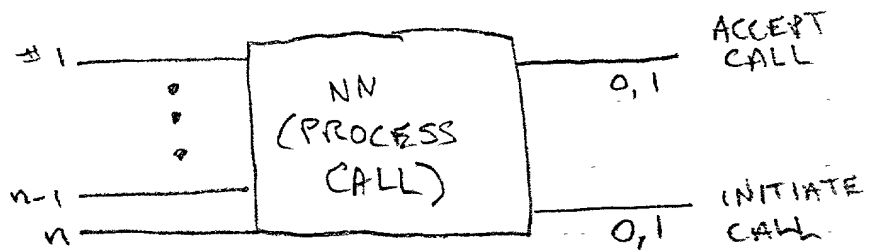


FIG. 4

**DECLARATION AND POWER OF ATTORNEY**

As a below named inventor, I hereby declare:

That my residence, post office address and citizenship are as stated below next to my name.

That I verily believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural inventors are named below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

**NEURAL NETWORK FOR CONTROLLING CALLS IN A TELEPHONE SWITCH**

the specification of which is attached hereto.

That I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

That I acknowledge the duty to disclose information to be material to patentability of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

That I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate on this invention having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)          None

I hereby claim the benefit under 35 U.S.C. §119(e) of any United States provisional application(s) listed below.

\_\_\_\_\_  
(Application Number)

\_\_\_\_\_  
(Filing Date)

\_\_\_\_\_  
(Application Number)

\_\_\_\_\_  
(Filing Date)

That I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

United States Application(s)

\_\_\_\_\_  
(Application Serial No.)

\_\_\_\_\_  
(Filing Date)

\_\_\_\_\_  
(Status)-(Patented, pending, abandoned)

\_\_\_\_\_  
(Application Serial No.)

\_\_\_\_\_  
(Filing Date)

\_\_\_\_\_  
(Status)-(Patented, pending, abandoned)

That all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

I hereby appoint the following attorneys, with full power of substitution and revocation, to prosecute this application and to transact all business in the United States Patent and Trademark Office connected therewith and request that all correspondence and telephone calls in respect to this application be directed to WELSH & KATZ, LTD., 120 South Riverside Plaza, 22nd Floor, Chicago, Illinois 60606, Telephone No. (312) 655-1500.

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